

PEOPLE AND NATURE

ADAPTING TO A CHANGING CLIMATE

Charting Maine's Course

A Summary of
the Report Presented by The Maine Department of Environmental Protection to
The Joint Standing Committee on Natural Resources of the 124th Maine Legislature

FEBRUARY 2010

III. FINDINGS

A. Guiding Principles and Unifying Themes

From the beginning of the stakeholder process, participants have sought to identify and utilize principles on which they could agree to base their decisions and recommendations. As the work has proceeded, certain common themes have emerged across the boundaries of working groups. These are combined here as the basis for the participants' efforts, and presented as guidance for further policy development.

- ❖ **Climate change affects everyone.** It is likely to have broad economic, biological and social implications for all of Maine. Although there is uncertainty as to the extent, rates and precise locations of change, we know that contemporary climate change is already affecting us, and will continue to do so. We have enough data to begin to act now, even as we gain understanding and capacity to respond more thoroughly over time. There are actions worth taking because they will benefit Maine regardless of the specific path of climate change. Society makes decisions to invest in preventive, responsive, or adaptive action based on uncertain risks all the time. The task is to balance the costs of responsive and preemptive action against the risks and potential costs of inaction.
- ❖ **Maine's adaptation planning must involve everyone.** It must include individuals, business and industry, public interest groups, land owners, and government at all levels. Policy decisions must be collaborative, transparent, and open to change as our knowledge increases and new circumstances present themselves. Planning for climate change adaptation will also benefit from the participation of Maine's state, regional, and local entities in broad-based approaches that cross political boundaries at both the local (watersheds, habitats and estuaries) and state (Gulf of Maine; New England) scales.
- ❖ **Climate change adaptation will require an on-going effort.** It will need to incorporate new information and continue to adapt and evolve. Consequently, data-gathering, monitoring, and assessment are critical tools that Maine must utilize to inform decision makers, resource managers, stakeholders, and the public. Our decisions must be founded on the best available scientific data. Thus, Maine's planning must support continuing research so we may provide the public with accurate information about the pace and extent of change. Meaningful communication of climate science and potential solutions is necessary to assist people throughout our state to take action.
- ❖ **We need to keep our natural systems resilient to likely changes.** Maintaining healthy ecosystems is essential to our long-term success in meeting the challenges of a changing climate. Natural ecosystems provide services such as clean water, food, energy, coastal protection, and carbon sequestration, but these systems are likely to be increasingly vulnerable to climate impacts. Our efforts to build resilience for Maine's communities and people must go hand-in-hand with strategies that minimize both impacts to the natural environment and losses of ecosystem services upon which we and Maine's natural resources depend.

- ❖ **Adaptation includes reducing existing stresses on natural and human systems.** Where we are unable to avoid climate-related stressors, limiting other compounding stresses that already exist is an effective form of adaptation to climate change. Our recommendations should specify which current stressors are likely to be exacerbated by climate change impacts. By taking a hard look at these, we may find ways to improve our adaptation methods and promote resilience in natural and human systems.
- ❖ **Some positive changes will occur.** A changing climate will create new economic opportunities for Maine. These will occur in many sectors and industries. Our planning must recognize and promote these opportunities, and develop incentives that will allow us to take advantage where possible. Climate change may increase Maine's competitive advantage in a number of sectors.
- ❖ **Maine must prepare for both incremental and acute impacts.** Although most climate change effects are taking place in steps over time, some will be episodic and unpredictable, such as insect outbreaks in Maine's forests or greater impacts to coastal areas from combined sea level rise and increased storm intensity. Maine's adaptation efforts must work simultaneously to address slower-arriving impacts and those that are more immediate or acute. Proactive infrastructure design, early detection, and well-developed response plans are among the steps needed to minimize future losses.
- ❖ **Maine should avoid unfairly passing the financial burden of inaction to future generations.** To the extent possible, Maine's climate planning efforts should seek to avoid passing to future generations what are likely to be the potentially catastrophic costs of inaction in some areas. This report aims to alert businesses, communities, and landowners – our neighbors – to the real and often imminent impacts of climate change, and demonstrates that effective planning is possible and cost effective. While we face serious limits on our current finances, the magnitude of cumulative cost over time must be considered. At the same time, Maine's plan should avoid passing on unfunded mandates to state agencies, municipalities, and landowners, with an eye toward reducing public costs while respecting private property rights and real estate values.
- ❖ **Maine can use existing policies and programs to address climate change.** Maine should continue to use current policies (e.g., laws, rules, regulations, and programs) that successfully address climate change. We should avoid creating new programs or institutions, and instead focus on enabling existing ones to function better in the service of climate change adaptation goals, consolidating functions and reevaluating policy where possible and appropriate.
- ❖ **Some communities may be more vulnerable than others.** Some of Maine's communities and people will be disproportionately affected by climate change. Our planning and implementation efforts must include their participation, and take special account of their needs.
- ❖ **Maine must maintain its commitments to reduce greenhouse gas emissions.** Adaptation should not be viewed as an alternative strategy to reducing our GHG emissions. Many of the actions to mitigate emissions go hand-in-hand with those needed to respond to climate changes we are already experiencing, and to build resilience for the expected climate future.

Forests and Agriculture

The forestry section of Maine's mitigation plan focuses on actions to preserve and enhance Maine's forests and timberlands in the interest of carbon sequestration and the production of sustainably-grown wood for biomass energy and long-lived products. It also notes the increasing pressure from development that has converted forests to other uses in recent years. As indicated below in this report, maintenance of the forest is a key element in assuring those ecosystem services necessary to the support of wildlife and fish in a changing climate regime, and to water quality for human use. Since more than 90% of our forests are privately owned, it will be important to provide landowners with incentives and support for keeping Maine's land forested. Thus, there are explicit links to:

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| <i>Strategy B.3.2</i> | <i>Maintain and Enhance Urban and Community Forests</i> |
| <i>Strategy C.3.1</i> | <i>Build Maine's Knowledge Base on Potential Climate Impacts to the Forest Environment</i> , with recommendations on pest and pathogen management, and ongoing research on changes in species composition, etc. |
| <i>Strategy C.4.1</i> | <i>Include Climate Change Effects on Wildlife and Habitat in Land Conservation Planning and Decision-making</i> , with accompanying recommendations |
| <i>Strategy C.4.2</i> | <i>Expand Current Efforts to Maintain and Restore Critical Wildlife Habitat and Assure Connectivity.</i> |

***Recommendation C.2.3.1** Maine should maintain and develop ongoing monitoring programs to assess changes in the status of diadromous and coastal marine resources.

***Recommendation C.2.3.2** Maine should expand its capacity to monitor and assess threats to coastal marine resources and the industries that depend on them, such as harmful algal blooms and invasive species.

C.3 Forest Resources

Forested lands cover approximately 90% of Maine, and the forest products industry has been central to the Maine economy for generations. In recent years, our working forests are recovering from the effects of the spruce budworm epidemic of the 1970's -1980's and concurrent salvage and pre-salvage harvesting. Growth in Maine forests currently is balanced with or exceeds harvest in the state as a whole, and the average growth to harvest ratio is 1.15.⁴² Maine's forest cover is now more extensive than at any time since 1760.⁴³

At the same time, since growing forests remove carbon dioxide from the atmosphere and sequester the carbon, the forest has an increasingly vital role in mitigating CO₂ emissions caused by human activity. As a result, there will be an increasing emphasis in coming decades on

Changes in Maine's forests will create both challenges and opportunities, as "traditional" species become less prevalent, and other valuable species take their place on the landscape.

keeping Maine's forestlands intact, and on forest management practices that increase carbon storage while at the same time producing sustainable and renewable biomass for wood products and energy. These actions were highlighted in the 2004 *Climate Action Plan for Maine*, which also emphasized the importance of preventing loss of forestland to development.

A strong forest economy is intimately linked to the retention of forest ecosystems. As highlighted in sections C. 4 and C.6 [pp. 60, 66], in addition to fiber production and carbon sequestration, the forest environment provides essential ecosystem services such as providing wildlife habitat and biodiversity, and maintaining the supply and integrity of freshwater

⁴² Laustsen, K. 2009. 2006 Mid-Cycle Report on Inventory and Growth of Maine's Forests. Maine Forest Service: Augusta, ME. http://www.maine.gov/doc/mfs/pubs/midcycle_inventory_rpt.html

⁴³ Table 2 from Irland, Lloyd C., Maine's Forest Area, 1600-1995: Review of Available Estimates. Maine Agricultural and Forest Experiment Station Miscellaneous Publication 736. February, 1998.

resources. This section focuses on the forest products industry, to which the effects of greatest concern are:

- Any combination of impacts that influences the migration into Maine of pests and pathogens that have not historically been present, or increases the efficacy of those that are;
- Overall changes in temperature and seasonality affecting forest composition as species currently at the southern edge of their range retreat, and those at their northern species boundary become part of Maine's forest; and
- The possibility that wood product harvesting equipment will need to be retooled to work effectively on increasingly saturated soils as the extent and duration of winter frozen ground changes.

However, it should be noted that climate impacts may also have positive impacts on Maine's forest economy. Among other possibilities

- There is some evidence that growth rates for existing trees will increase due to overall warming, and increased CO₂ and nitrogen availability⁴⁴;
- Even as spruce retreats over time, the white pine forest that feeds an important saw log market is likely to establish a greater foothold; and
- The demand for wood pellets as an alternative energy source is already increasing.

Strategy C.3.1 Continue to Build Maine's Knowledge Base on Potential Climate Impacts to the Forest Environment

As with other sectors, monitoring and detection will continue to play a key role in responding to climate change. Of particular importance are tracking the introduction and spread of pest and pathogens, the virulence of native and introduced pests, changes in forest condition that precede critical compositional and functional change (e.g., phenology⁴⁵, growth rates, nutrient cycling), the physical climate trends of the forest (e.g., local temperatures, snow depths, frost penetration, soil moisture), and ultimately evidence of species shift. At the same time, there are needs for a regional monitoring network to detect and track pest and pathogen occurrences, and for increased outreach to landowners and the public on identification of, and responses to, pest/pathogen, forest growth and species migration changes. This will require enhancing Maine's scientific and resource management capacity in this area.

⁴⁴ McMahon, Sean M; Geoffrey G. Parker, and Dawn R. Miller, Evidence for a recent increase in forest growth, *Proceedings of the National Academy of Sciences* (2010)
<http://www.pnas.org/content/early/2010/02/02/0912376107>

⁴⁵ The timing of natural phenomena such as date of blooming.

Recommendation C.3.1.1 Initiate a state-level planning process for pest and pathogen management over the long term. The planning process should include the development of “off the shelf” plans that anticipate, and allocate resources to respond quickly to, likely specific pest / pathogen outbreaks.

Recommendation C.3.1.2 The University of Maine, in partnership with industry, should expand ongoing research effort to assess the likely impacts of climate change on Maine’s forest industries by (a) updating growth and yield models for current and projected forest species; (b) modeling future forest conditions and productivity for different climate scenarios; (c) identifying forest practices likely to protect forest productivity, and decrease vulnerability to climate change-related stresses; and (d) assessing the position of the Maine forest products industry in the global marketplace.

Strategy C.3.2 Increase Maine’s Capacity to Respond to Future Hydrological Change: Forest Roads and Stream Crossings [see C.6.1, p. 66]

The road network through Maine’s working forest is vital to the forest products industry. As the climate regime changes, likely increases in precipitation and runoff will make this network vulnerable to outage. At the same time, managing streamflow is critical for wildlife connectivity.

C.4 Wildlife and Biodiversity

As Maine people come to grips with the likely foreseeable impacts and effects of climate change, their focus is frequently on our neighbors, businesses, and communities. Yet the real context of adapting to climate change is the entirety of the natural world, and this challenge reminds us of the inter-connectedness of life on our planet.

When we consider the likely impacts on Maine’s natural environment and the species that inhabit it, the following concerns stand out:

- Changing seasonal variation and increase in temperature will have particularly acute effects on plant and animal species that are dependent on relatively small, isolated, or distinct ecosystems, or that exist in Maine at the current boundary of their historic range;
- Human influences on the natural environment, such as land development, natural resource harvesting, and environmental pollution, both in Maine and elsewhere (for migra-

tory species that pass through Maine or spend a portion of their life cycle here) are already stressing a multitude of species independent of climate effects;⁴⁶

- The influence on habitat and native species from new pests and pathogens, increased efficacy of existing pests/pathogens, and invasive species, will be exacerbated as the climate changes;
- Aquatic ecosystems are particularly vulnerable to shifting parameters associated with hydrologic change (extremes of high and low flows, increasing temperature) and extreme weather events resulting in erosion of sediments and nutrient loading; and
- Asynchrony in the timing of natural events (such as earlier blooming of plants to the detriment of species that depend on these for food but are not yet present)⁴⁷ is already producing changes in ecosystem function and species composition in particular ecosystems. Strategies and recommendations in this area are closely related to those in each of the other portions of this "Environment and Natural Resources" section.

Strategy C.4.1 *Include Climate Change Effects on Wildlife and Habitat in Land Conservation Planning and Decision-Making*

There is a clear need to incorporate the impact of climate change into conservation objectives, and to include evaluation of the potential contribution of land conservation plans to adaptation and habitat resilience efforts. Among the factors to be included are maintenance of connectivity among habitats, terrestrial and aquatic; integration of wildlife management strategies across working forest, farms, and reserve lands; and climate considerations in the design, layout, construction, and management of recreational roads and trails. Beginning with Habitat [BwH], which includes the State Planning Office, Department of Transportation, Department of Conservation, and Department of Inland Fisheries and Wildlife in partnership with Manomet Center for Conservation Sciences, is undertaking a climate change vulnerability assessment for Maine's 213 wildlife "Species of Greatest Conservation Need," Maine's listed threatened and endangered plant species, and Maine's rare natural community types. This information will be used to update Maine's State Wildlife Action Plan and will inform municipal, landowner, and land trust outreach efforts through BwH.

Recommendation C.4.1.1 Update current state-level land use plans and conservation priorities using "Beginning with Habitat" at state, regional, and local scales to

⁴⁶ For example, moose and bear have adapted well to the current management of the northern working forest while white-tailed deer have declined in the same region.

⁴⁷ Also called "phenological change."

evaluate risks of habitat loss and degradation and develop appropriate solutions to maintain terrestrial and aquatic ecosystem connectivity.

Recommendation C.4.1.2 Increase land and water conservation funding for projects that are focused on adaptation to climate change; and ensure funding for the continued coordination of inventory, prioritization, data management, outreach, and restoration project development to mitigate current and future impacts on stream connectivity. Build climate change considerations into existing criteria and scoring systems for all conservation funding.

Recommendation C.4.1.3 Assess and modify, as needed, the state's Ecological Reserves Monitoring Plan to address habitat questions related to climate change. Evaluate the vulnerability of the state's Ecological Reserves to climate change, and incorporate climate change into the criteria for selection and design of new Ecological Reserves.

Strategy C.4.2 *Continue and Expand Current Efforts to Maintain and Restore Wildlife Habitat and Assure Connectivity*

Various federal and state agencies and public interest groups are already active in this area. For example, Acadia National Park has submitted a number of proposals as part of their climate adaptation planning process to assess potential impacts to coldwater fisheries, wetlands, and coastal estuaries. BwH is in the final stages of a statewide habitat connectivity assessment that will inform state, regional, and local land use decisions. Additionally, BwH is partnering on a multi-state and province effort to identify strategic conservation options to maintain habitat connectivity across the northern Adirondacks from New York to New Brunswick.

Recommendation C.4.2.1 Maine's state agencies involved in this area should continue to collaborate with the University of Maine, public interest groups, federal agencies, and other interested parties, to continue development and improvement of systems to monitor, study and report the health of native wildlife systems and species, and track the spread of invasive species that may emerge in Maine as a result of climate change.

Large-scale efforts to inventory stream crossings for fish passage have been underway for several years in Maine.⁴⁸ The data from these efforts is being compiled and analyzed to determine the most at-risk crossings and those that block the most and best habitat for important wildlife species, such as Atlantic salmon and Eastern brook trout. The US Fish and Wildlife Service Gulf of Maine Project is leading a multi-partner effort to assess these data and modeling the best restoration/ renovation projects.

Improving stream flow through culverts not only assists habitat connectivity for wildlife, but builds resilience into stream crossing infrastructure.

In 2009 Governor Baldacci directed state, federal and NGO entities active in aquatic connectivity restoration to collaboratively identify the most efficient and effective way for these agencies, NGOs, the public, and others to share data and information collected through often parallel, but disparate, research efforts. This effort, the Maine Interagency Stream Connectivity Work Group, is actively developing solutions for data collection, analysis, cooperative funding, management, and outreach. There are millions of federal dollars that could be used to improve state, local, and private infrastructure if stream restoration were a concerted effort based on broadly-available scientific information. This work group hopes to improve coordination and efficiency in restoration, and assure that any public communication uses a common language.

Improving stream flow through culverts and other crossing infrastructure can increase the ability of aquatic and riparian species to move between habitats bisected by a road or other development. Improvements such as increasing flow capacity or changing the type of crossing structure can have the added benefit of making a crossing more able to withstand more frequent, extreme rainfall events and the resulting episodic storm flows. [see also B.2.2, p. 39]

Recommendation C.4.2.2 State agencies should cooperate with federal funding agencies to expand the use of restoration and hazard mitigation grant programs to creatively fund state and local infrastructure improvements that would proactively increase flow capacity and habitat connectivity. State match for such funding could be in the form of state dollars, expertise, and/or capacity building.

⁴⁸ The largest is a Maine Forest Service project with assistance from USFWS, IF&W, and The Nature Conservancy to inventory road-stream crossings in the Penobscot River Watershed. Several thousand crossings have been inventoried showing that about 50% are severe barriers to fish and wildlife movement because they are undersized, perched, damaged or unmaintained. Many of these are also clearly hazards for future transportation. Some of the other efforts are taking place for the Ossipee, Presumpscot, Royal, Sheepscot, Narraguagus, and Machias Rivers.

Recommendation C.4.2.3 Assess the effectiveness of state regulations and programs that include standards related to aquatic organism passage and natural stream flow in light of likely climate change effects

Recommendation C.4.2.4 The "Beginning with Habitat" Steering Committee should collaborate with municipalities and landowners, and the Interagency Stream Connectivity Work Group, to identify habitat connectivity priorities and efficiently distribute habitat connectivity data. Municipalities and conservation organizations can utilize this information to develop strategies to maintain, enhance or restore connectivity at the state and local levels.